

Fish passage through culverts:

Biological perspectives

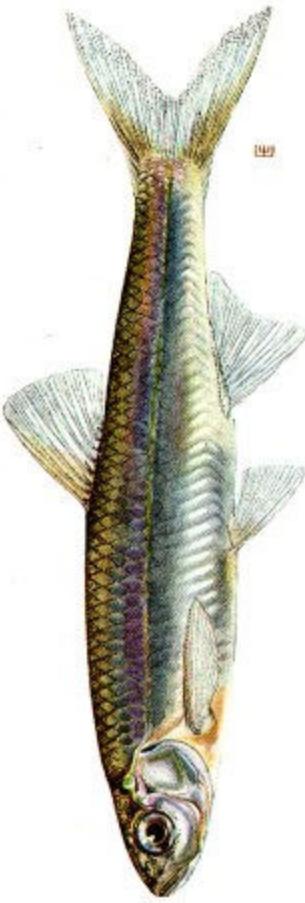


Why fish passage is important



Importance of fish passage

- It's not 'just fish!'



- Recreational
- Ecological
- Economical

Recreational angling

- More than 260,000 anglers.
- Fishing is the most popular outdoor sport here.
- Maine is considered the last 'stronghold' of wild Brook Trout in the east.
- Potentially - up to a quarter of anglers non-consumptive users.

Ecological Importance of streams and brooks

- Over 6,000 miles of ‘named’ streams – may be up to an equal length of unnamed and intermittent brooks.
- Move organisms and materials.
- Store flood waters.
- Create landscape.
- Are important to other species of wildlife besides fish.
- Health is directly related to surrounding land.

Economic Importance

- Fishing: \$100 million in wages and salaries. \$200 million in retail sales, \$20 million in tax revenues.
- Stream fishing is an important mainstay in many rural economies throughout the state.
- ‘Healthy’ streams greatly reduce flood damage and associated costs.

OK, so it's important: What's the problem??

- Culverts that are improperly designed and\or installed 'fragment' habitat.
- *HABITAT* – the set of resources needed to survive and reproduce – ‘living space’
- *FRAGMENTED* habitat – when portions of ‘living space’ are separated from one another.
- Improperly designed, installed and maintained culverts are MAJOR ‘fragmenters’ of running water habitats.
- With a design life of 30+ years, are fairly long-term barriers.

Culverts

- Commonly 12' diameter or smaller.
- Come in a variety of shapes.
- Made of stone, concrete, metal or plastic.
- Can be retrofitted.



Culvert: a *static* structure in a *dynamic* habitat

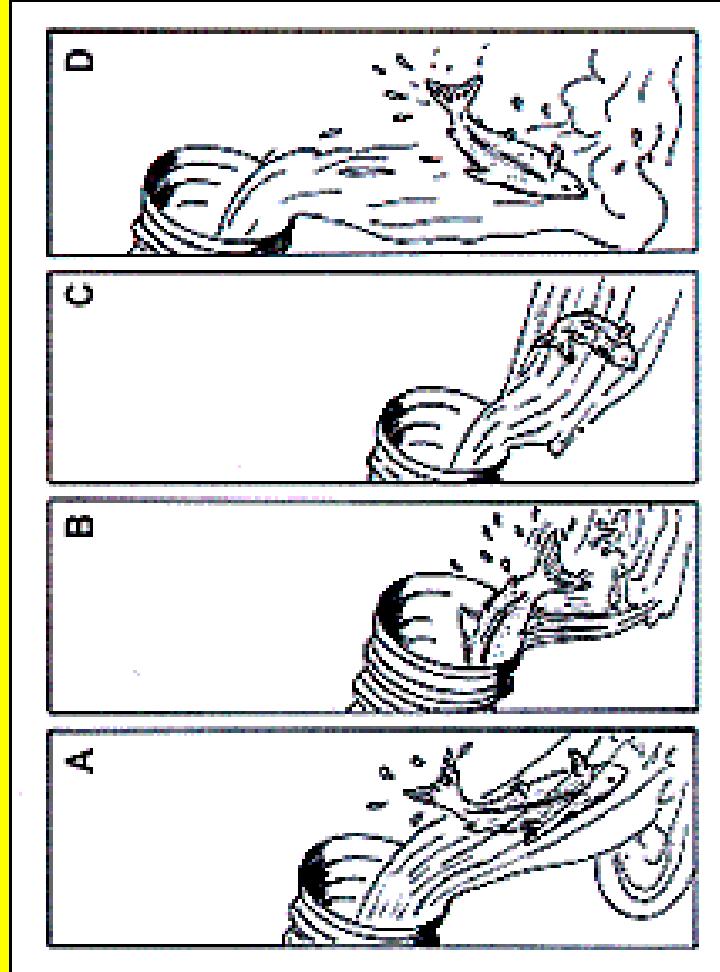
- ‘No design’ common practice.
- Traditional design efforts usually limited to:
 - Cost.
 - Some pre-determined discharge volume.
- This approach results in many inappropriate passage situations – installations are usually undersized.
- Past and current focus on installation not maintenance.
- Streams move vertically and horizontally, culverts do not.

How widespread is the problem?

- Potentially 30% or more of culvert installations are insufficient for fish passage or create barriers to flow.
- Culverts used primarily on smaller waterways – which make up a larger proportion of the total stream miles.
- Increased recent use of liners has quickly ‘upped’ the number of barriers.



HOW do culverts block fish passage?



- Flow too fast.
- Flow too shallow.
- Too steep.
- Outlet 'perched'.
- 'Thermal dam'

Flow too fast



Flow too shallow



Too Steep



Outlet 'perched'



'Thermal dams'



How do we avoid causing fish passage barriers?

- Size culverts appropriately.
- Set pipe invert to below streambed elevation.
- Match gradient of culvert to that of stream.
- Limit use of liner structures to specific situations.
- Limit vegetation removal to work area.
- Limit use of rip rap to bank-full area of stream.
- Use mitigating structures when necessary.
- More on all of this stuff coming up.....

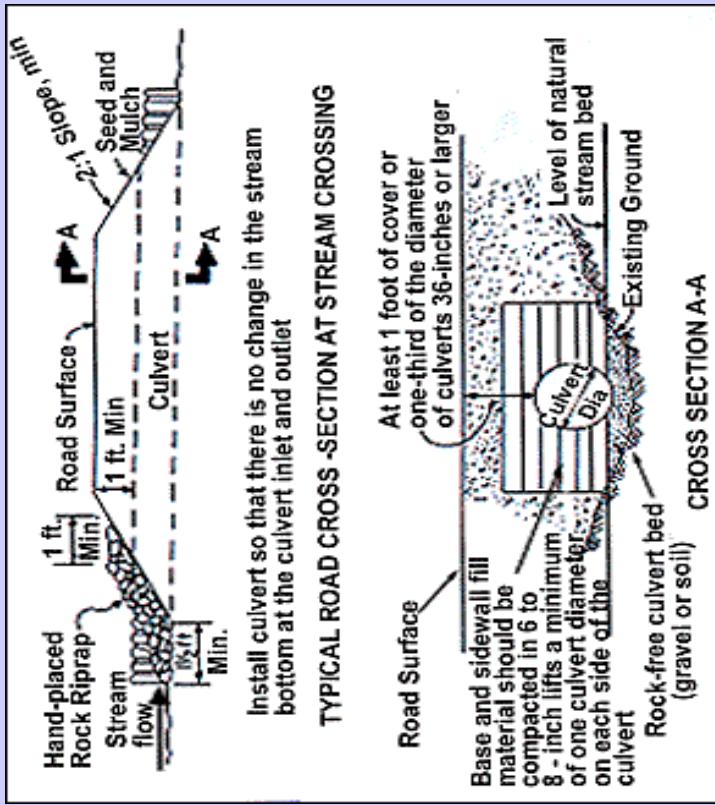
Sizing culverts appropriately



- Current CWA PGP requires diameter to be 1.2X bank-full width.
- Recent research shows that eastern streams may be at bank-full 8% of the time – the bigger the bore the better!
- Remember that wildlife species use culverts too.

Set pipe below streambed elevation

- Embed pipes with diameters of <4 ft.: 6 in. below existing substrate elevation.
- Embed pipes >4 ft. diameter: 12 in. below existing substrate elevation.



Match Gradients of culvert and stream

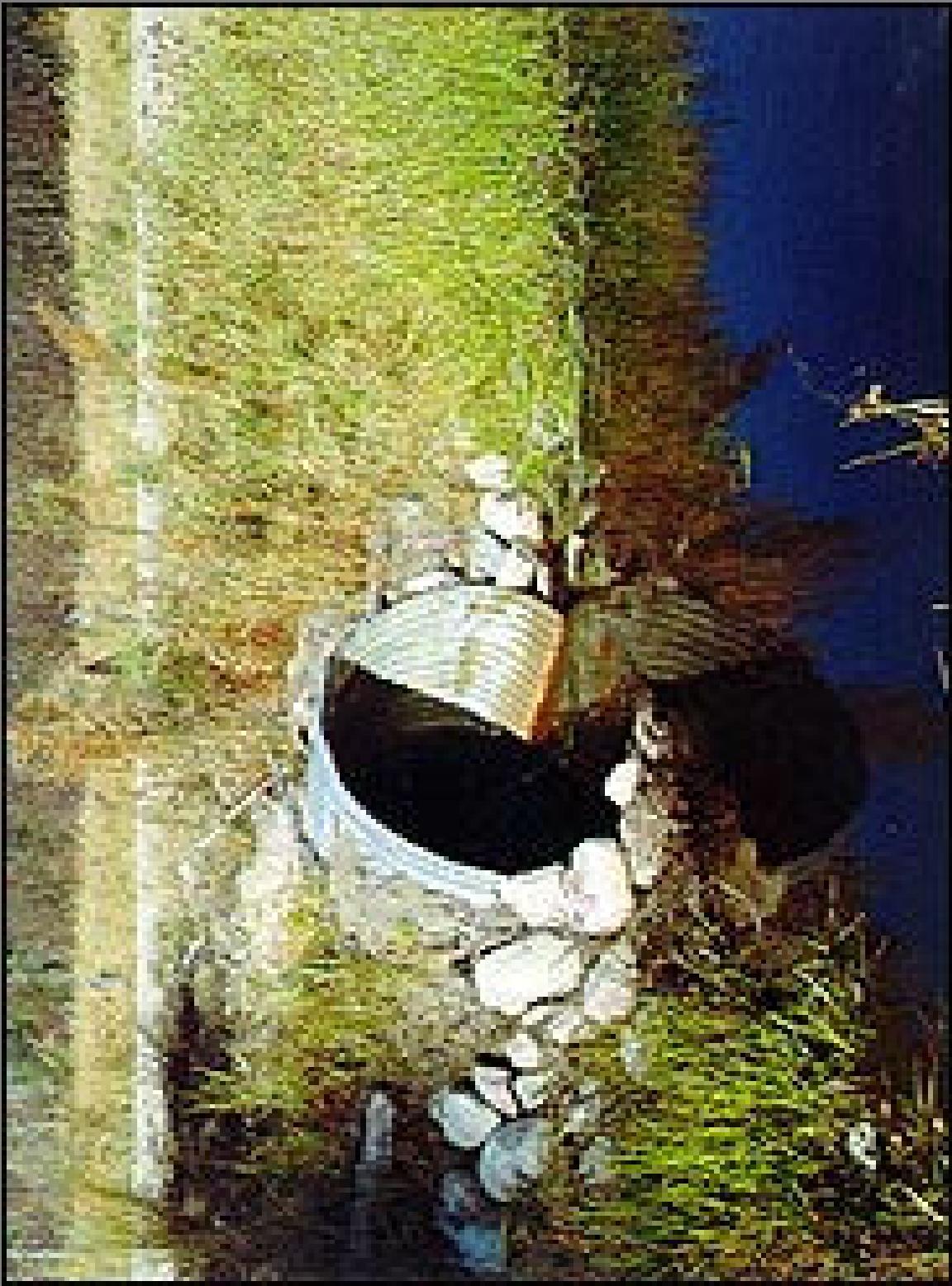
- Up to 3% gradient: embed pipe at average slope angle.
- Above 3% gradient: External drop structures required to average slope –
 - Log or stone weirs.
 - ‘Built’ riffles
 - Pool and drop structures
 - Context specific designs



Limit use of liner structures



- Drainage ditches.
- Non-waterway drives and entrances.
- Culvert with <2% gradient that have 12 in. or more of water depths at low flows.
- Culverts with sufficient ROW that allow construction of external structures.



Limit vegetation removal\rip rap use

- Banks stay stable.
- Rip rap above wetted area acts as a heat sink.
- Salvage vegetation/topsoil at site.



Mitigating structures

- Don't have to be expensive.
- Don't have to be complicated.
- Many are still in design/monitoring stages.
- External, not inside the pipe if it is under 6' diameter!
- Are useful for more than fish passage.

Concluding remarks

- Survey necessary to determine the extent of culvert barriers.
- Do cost savings on installation result in higher maintenance costs?
- Soil mechanics, hydraulics and geomorphology need to be considered in design.
- Guidance for sizing, installation, mitigating structures and maintenance necessary.